First dual-gradient-ready drilling riser is introduced

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THE IDEA OF DUAL GRADIENT drilling has been floating around the industry for a long time, promising more profitable well completions in ultra-deepwater environments.

Three large independent efforts are currently in the process of developing a commercial solution to dual gradient drilling and 2001 will be the year we see actual field testing of the dual gradient concept.

In anticipation of what promises to be a significant advance in deepwater drilling, **Stewart & Stevenson** has introduced the industry's first riser system specifically designed to meet the future requirements for offshore deepwater drilling projects.

It is designed to take full advantage of dual gradient drilling and underbalanced drilling without sacrificing the ability to be used as a conventional drilling riser system.

DUAL GRADIENT DRILLING

Dual gradient drilling emerged as one possible answer to a challenge present in deepwater environments.

In certain formations, additional casing strings may be required to maintain well bore pressure balance and bore hole stability.

Unfortunately, this can prevent the well from reaching target depth with sufficient borehole size to make the well economically feasible.

To address this challenge, the idea of dual gradient drilling was introduced as a way to remove the hydrostatic pressure of the drilling fluid column between the ocean floor and the drilling rig from the wellbore pressure.

A subsea pumping system is used to return the drilling fluid from the well to the rig. In some cases, the subsea pump could also separate out the drill cuttings and deposit them into a separate dummy well; otherwise, the pump would carry the cuttings and drilling fluid back up to the rig.

Another key component is the need to isolate the seawater in the riser from the drilling fluid in the well.

This can be accomplished either with a simple fluid-to-fluid interface above the wellhead or using a mechanical isolation tool separating the fluid in the riser from the fluid in the wellhead.

MECHANICAL ISOLATION TOOL

In dual gradient drilling, a fluid-to-fluid interface at the top of the blowout preventer (BOP) stack is maintained by the subsea pumps, which maintain their inlet pressure at ambient seawater pressure.

The downside of a fluid-to-fluid interface is the mixing of the drilling mud with seawater and the possibility that a gas kick will go up the riser.

A mechanical isolation tool will eliminate these problems. For dual gradient drilling, Stewart & Stevenson has also introduced the SSIT™ (Stewart & Stevenson Isolation Tool), which provides positive isolation between the riser and the BOP.

The SSIT is full bore with the insert packer removed, making it invisible to the riser drilling string during conventional drilling and allowing casing hangers to pass through to the wellhead.

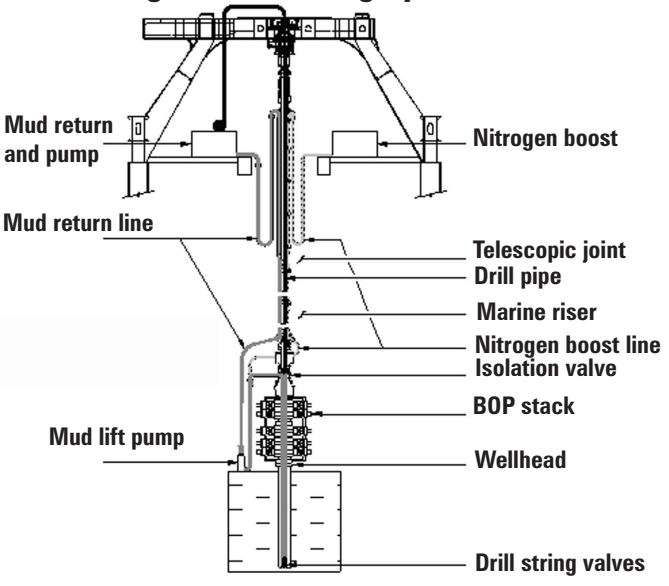
The insert packer is run and retrieved on the drill pipe through the riser. The SSIT uses a mechanical design that effectively separates the riser from the well, giving added control to the dual gradient project.

By mechanically isolating the dual densities of the fluid in the riser and the fluid in the BOP, the hydrostatic head at the sea floor is created by the seawater in the riser and is equal to the surrounding pressure at the mud line.

If drilling fluid were used in the riser, the hydrostatic pressure at the wellhead would be much greater due to the greater density of the fluid versus seawater.

By making the well perform as if the rig were sitting at the sea floor directly above the well, dual gradient drilling improves hole stability, permits deeper drilling with less well fracturing, reduces the number of different casing strings required and reduces the overall risk of the project.

S&S dual gradient drilling system



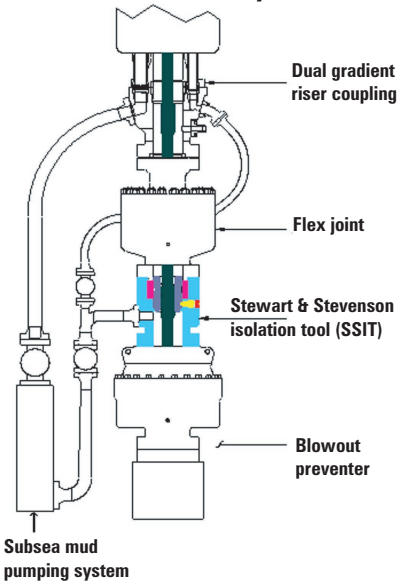
RISER FEATURES

Although some companies are proposing dual gradient systems that utilize concentric risers (one inside the other), the majority of systems utilize a conventional riser with a separate fluid return line.

Stewart & Stevenson's DMRS™ (Drilling Mud Return marine riser System) smoothly integrates a 7-in. fluid return line into the riser, along with choke and kill lines, booster line and hydraulic line.

Combining these components into the riser cuts down on the number of sepa-

Isolation tool assembly



rate strings the rig has to manage. This is important because using multiple strings makes it more difficult to weathervane the drill ship into the wind, since a ship can more easily rotate around a single point in the moon pool.

Use of a fluid return line will not only be used in dual gradient drilling, it also offers advantages in conventional drilling.

The Stewart & Stevenson patented dual gradient coupling is in service on deepwater drilling rigs.

Using a smaller fluid return line increases the velocity of the return flow to 3 times that of the riser without the use of the booster line, making it easier to carry the cuttings out of the well. This would require a high-pressure rotary isolation tool.

Combined with nitrogen injection, glass beads or foam, this may eliminate the need for subsea pumps for dual gradient drilling.

The increased velocity of the return line, along with eliminating flow variations caused by the motion of the telescopic joint, produces a less sporadic flow of return fluid to the mud separating equipment or shakers.

This allows the flow rate to be monitored with greater accuracy for signs of a gas kick, and keeps the flow steadier and easier to manage.

Reducing the sporadic nature of the return flow increases the overall safety of the operation.

REDUCED MUD

Of course, there is an obvious consequence in using a 7-in. diameter drilling fluid line as opposed to a typical 19-in. internal diameter riser—the amount of drilling fluid is reduced by two-thirds.

This makes the riser more environmentally friendly since the smaller volume of fluid reduces the negative environmental impact in the event of an emergency disconnect.

Other benefits derived from the reduction of drilling fluid could include:

- Reducing the required drilling fluid storage capacity on the rig;
- Reducing the time required to change fluid weights;
- Reducing the time required to circulate the drilling fluid in or out of the well;
- Reducing the dilution of the down hole drilling mud with mud from the booster line;
- Reducing the tensioner requirements of the riser;
- Reducing the amount of tensioning capacity required on the rig;
- Reducing the wear and maintenance on the tensioner.

The DMRS riser is based on the 3.5M type SSQR-F3 riser flange coupling now in service on the **Global Marine** ultra-deepwater drill ships.

The design features field-replaceable pins and boxes on the flowlines.

To save weight, the flanges have been trimmed with patent pending offset arcs on both sides of the mud return line.

These arcs reduce the weight of the flanges and allow the riser to be handled by the gate-type spider.

CONCLUSION

Dual gradient drilling, once it is perfected, will enable companies to drill deeper in challenging field formations at reduced cost and risk, making these projects more profitable.

Although normal deepwater drilling techniques will continue to dominate for years to come, dual gradient drilling gives the industry a valuable tool to overcome obstacles to even greater production that was previously unattainable.